

# How To Help Your Students Design Their Own Investigations

Encouraging students to conduct science investigations is at the heart of GLOBE's approach to education. Your students can use data from their own GLOBE Study Site, as well as data from other schools, to ask questions, seek answers by looking at real data, pursue their own interests, establish partnerships with other schools throughout the world, and explore the interconnections among the various phenomena which comprise the Earth system. The investigation *Seasons: Putting It All Together* provides a series of learning activities using local and global data to answer questions. Students may design their own investigations as well. This section contains some thoughts to keep in mind as you proceed.

Remember, although investigations can be a lot of work, joy usually accompanies satisfying one's own curiosity and gaining new understanding.

1. The nature of your investigations will depend on local factors. While GLOBE offers an incredibly rich resource of worldwide data and potential areas of investigation, the exact nature of student investigations will vary from school to school. It will depend on the characteristics of your own GLOBE Study Site, the GLOBE data you use, the interests of your students, your own interests and expertise, the capabilities and expertise that is made available to your students from their community, the technology available to you, the age and experience level of your students, and the amount of time that you have available.
2. Investigations should be based on student questions. Investigations begin with questions. Even if you focus students on a specific area, the investigations themselves must begin with questions that the students are sincerely asking. If they really want to find out the answer, then the rest of the investigation falls into place with

logic, meaning, and purpose for the students. This is crucial to their enjoyment of an investigation.

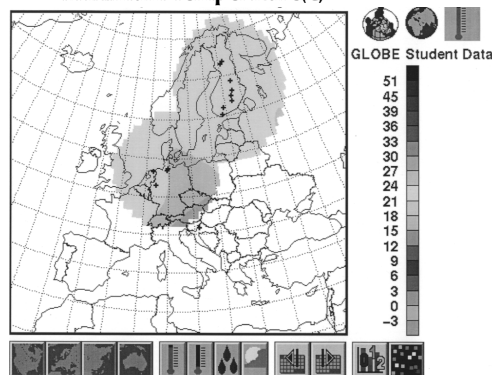
3. Students should take direct observations. Students' investigations should be grounded in their observations of the phenomena they are studying. This is what makes the investigation real for them - understanding how data correspond to actual phenomena they can observe.
4. Students should use data from the GLOBE Student Data Server. This database of student observations is a unique and valuable resource to support student research and learning. In one way or another, all investigations can take advantage of this increasingly rich database.
5. Students should build on what they know. Your students will collect data for the *Atmosphere, Hydrology, Soil, and Land Cover/Biology Investigations*. They should also do a variety of related learning activities to strengthen their understanding of the measurement protocols and resulting data. The investigations should build on this knowledge base.
6. Students should tap other sources of information. Using other sources of information does not mean that your students should rely on encyclopedias or other reference books to find answers. Rather, your students should pursue other sources of data and representations of these data such as images, graphs, tables of data, and other visualizations available through GLOBE. Historical data from local environmental agencies, Landsat TM and other satellite data, regional topographical maps, or Internet searches on the World Wide Web complement and extend the data resources directly provided by GLOBE. As much as possible, students should rely on and try to interpret primary sources of data, rather than standard textbooks. Of



course, books certainly provide explanations for phenomena that help students better structure their investigations.

7. Students should collaborate with other GLOBE students throughout the world. GLOBE epitomizes this in the scientists' reliance on data from thousands of students worldwide. Most Earth scientists work in teams because of the extensive nature of environmental research. So too, student investigations usually are strengthened or enabled by collaboration among several students who divide the responsibilities and share their thoughts. Because many GLOBE schools have telecommunications, student investigations can involve collaborations with other schools all over the world.
8. Your students can do investigations at any point in the year. All of the GLOBE investigations emphasize hands-on, inquiry-based approaches. The best time for an investigation is when the students are truly engaged and curious about something they see at their study site, in the GLOBE data, or in the news.
9. Investigations can be short or long. Some investigations can be done in a single day; others will take a lifetime. Help your students to set achievable objectives so that they can see results from their work before they lose interest.
10. Generally, there may be no single right answer. Students tend to assume that answers are either right or wrong, but for many questions, there is no single right answer. For example, if the question is "When is the rainiest time of the year?" your students will find different answers for different parts of the world, and they will find that rainy seasons do not always begin and end on specific days.
11. Most investigations are interactive and messy. The straight-line concept of the scientific method is not generally how science takes place. In many cases, one does not simply state a hypothesis, collect

#### Maximum Temperature(C)



*GLOBE Visualization, showing a map with student data.*

data, and prove or disprove the hypothesis. The process involves asking many questions, exploring the data, making guesses, doing more observations, rethinking the questions, checking other sources, discussing and arguing with colleagues, and questioning underlying assumptions. This is the reality of science, and it is an approach we hope your students will adopt.

12. One investigation will lead to another. If the topic is truly engaging for your students, one investigation likely will lead to another. For example, your students may determine the coldest day of the current year, but that in turn may lead to the question of why it was so early or late in the year, or whether other places in the world similarly had an early or late coldest day.
13. Explore local issues. GLOBE observations provide several perspectives on your local environment. Addressing a local issue may require your students to make other observations. You and they can seek out local organizations as collaborators. When students realize that they can contribute to their community or interact with scientists directly, it is often a boost to morale and confidence. Many areas of scientific investigation are pursued to satisfy individual curiosity, but environmental investigations almost always are done to meet a community or societal need for understanding as well.